MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2017/2018

ETM4116 – DATA AND MULTIMEDIA NETWORKING
(TE)

5 MARCH 2018
2:30 P.M. – 4:30 P.M.
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This Question paper consists of 5 pages with 3 questions only.
2. Attempt **ALL** questions. The distribution of the marks for each question is given.
3. Please write all your answers in the Answer Booklet provided.

Question 1

a) What is a protocol? What does a protocol define? [3 marks]

b) List five access technologies. Classify each one as home access, enterprise access, or wide-area wireless access. [5 marks]

c) What are the five layers in the TCP/IP protocol stack? What are the principal responsibilities of each of these layers? [10 marks]

d) i) Consider a packet of length L which begins at end system A and travels over three links to a destination end system. These three links are connected by two packet switches. Let d_i, s_i, and R_i denote the length, propagation speed, and the transmission rate of link i, for $i = 1, 2, 3$. Assuming no queuing delays, in terms of d_i, s_i, R_i ($i = 1, 2, 3$), and L, formulate the total end-to-end delay for the packet, assuming processing delays is d_{proc}. [3 marks]

ii) Suppose now the packet is 1,500 bytes, the propagation speed on all three links is 2.5×10^8 m/s, the transmission rates of all three links are 2 Mbps, the packet switch processing delay is 3 msec, the length of the first link is 5,000 km, the length of the second link is 4,000 km, and the length of the last link is 1,000 km. For these values, what is the end-to-end delay? [3 marks]

e) i) Suppose there are N packets arrive simultaneously to a link at which no packets are currently being transmitted or queued. Each packet is of length L and the link has transmission rate R. Prove that the average queuing delay for the N packets is (N-1)/2 x L/R. Hint: Second packet need to wait for first packet. Third packet need to wait for first and second packet. [3 marks]

(ii) Now suppose that the N packets arrive simultaneously to the link every NL/R seconds. How will this affect the average queuing delay of a packet? [3 marks]

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Question 2

a) Compare services provided by TCP and UDP. Why do HTTP, FTP, SMTP, and POP3 run on top of TCP rather than on UDP? [10+3 marks]

b) Describe how Web caching can reduce the delay in receiving a requested object. Will Web caching reduce the delay for all objects requested by a user or for only some of the objects? Why? [4 marks]

c) Consider the following string of ASCII characters that were captured by Wireshark when the browser sent an HTTP GET message. The characters <cr><lf> are carriage return and line-feed characters. Answer the following questions, indicating where in the HTTP GET message below you find the answer.

```
GET /cs453/index.html HTTP/1.1<cr><lf>
Host: gaia.cs.umass.edu<cr><lf>
User-Agent: Mozilla/5.0 (Windows;U; Windows NT 5.1; en-US;
rv:1.7.2) Gecko/20040804 Netscape/7.2 (ax) <cr><lf>
Accept:ext/xml, application/xml, application/xhtml+xml,
text/html;q=0.9, text/plain;q=0.8,image/png,*/*;q=0.5<cr><lf>
Accept-Language: en-us,en;q=0.5<cr><lf>
Accept-Encoding: zip,deflate<cr><lf>
Accept-Charset: ISO-8859-1,utf-8;q=0.7,*;q=0.7<cr><lf>
Keep-Alive: 300<cr><lf>
Connection:keep-alive<cr><lf><cr><lf>
```

i. What is the URL of the document requested by the browser? [2 marks]

ii. What version of HTTP is the browser running? [2 marks]

iii. Does the browser request a non-persistent or a persistent connection? [2 marks]

iv. Where can the IP address of the host on which the browser is running be found? [4 marks]

v. What type of browser initiates this message? Why is the browser type needed in an HTTP request message? [3 marks]

Continued...

Question 3

a) With HTTP streaming, are the TCP receive buffer and the client's application buffer the same thing? If not, how do they interact? [2 marks]

b) CDNs typically adopt two different server placement philosophies. Name and briefly describe these two philosophies. [4 marks]

c) Briefly describe two FEC schemes based on redundant transmission. [4 marks]

d) What are the challenges for streaming stored video? [6 marks]

e) Consider a DASH system for which each video are encoded using N video resolutions and N audio resolutions. Suppose we want to allow the player to choose at any time any of the video and audio resolutions, how many files will the server need to store for the following conditions:

i. The server sends only one media stream, the audio is pre-synched/mixed in with the video. [2 marks]

ii. The server sends the audio and video streams separately and has the client synchronizes the streams [2 marks]

f) How does CDN's DNS select "good" CDN node to stream to client? [6 marks]

g) Consider the Figure below. A sender begins sending packetized audio periodically at t = 1. The first packet arrives at the receiver at t = 8.

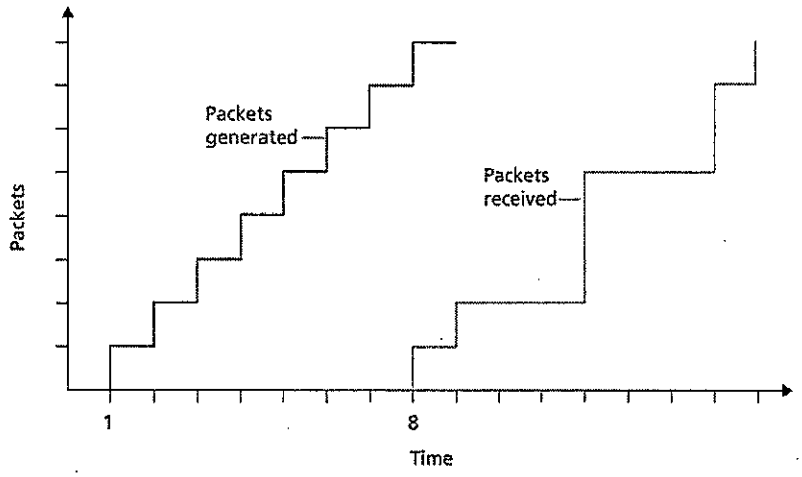

Figure 3

Continued...

i. What are the delays (from sender to receiver, ignoring any playout delays) of packets 2 through 8? Note that each vertical and horizontal line segment in the figure has a length of 1, 2, or 3 time units. [3 marks]

ii. If audio playout begins as soon as the first packet arrives at the receiver at t = 8, which of the first eight packets sent will not arrive in time for playout? [2 marks]

iii. If audio playout begins at t = 9, which of the first eight packets sent will not arrive in time for playout? [2 marks]

iv. What is the minimum playout delay at the receiver that results in all of the first eight packets arriving in time for their playout? [2 marks]

h) i. Suppose we send into the Internet two IP datagrams, each carrying a different UDP segment. The first datagram has source IP address A1, destination IP address B, source port P1, and destination port T. The second datagram has source IP address A2, destination IP address B, source port P2, and destination port T. Suppose that A1 is different from A2 and that P1 is different from P2. Assuming that both datagrams reach their final destination, will the two UDP datagrams be received by the same socket? Why or why not? [2 marks]

ii. Suppose Alice, Bob, and Claire want to have an audio conference call using SIP and RTP. For Alice to send and receive RTP packets to and from Bob and Claire, is only one UDP socket sufficient (in addition to the socket needed for the SIP messages)? If yes, then how does Alice's SIP client distinguish between the RTP packets received from Bob and Claire? [3 marks]

End of Paper